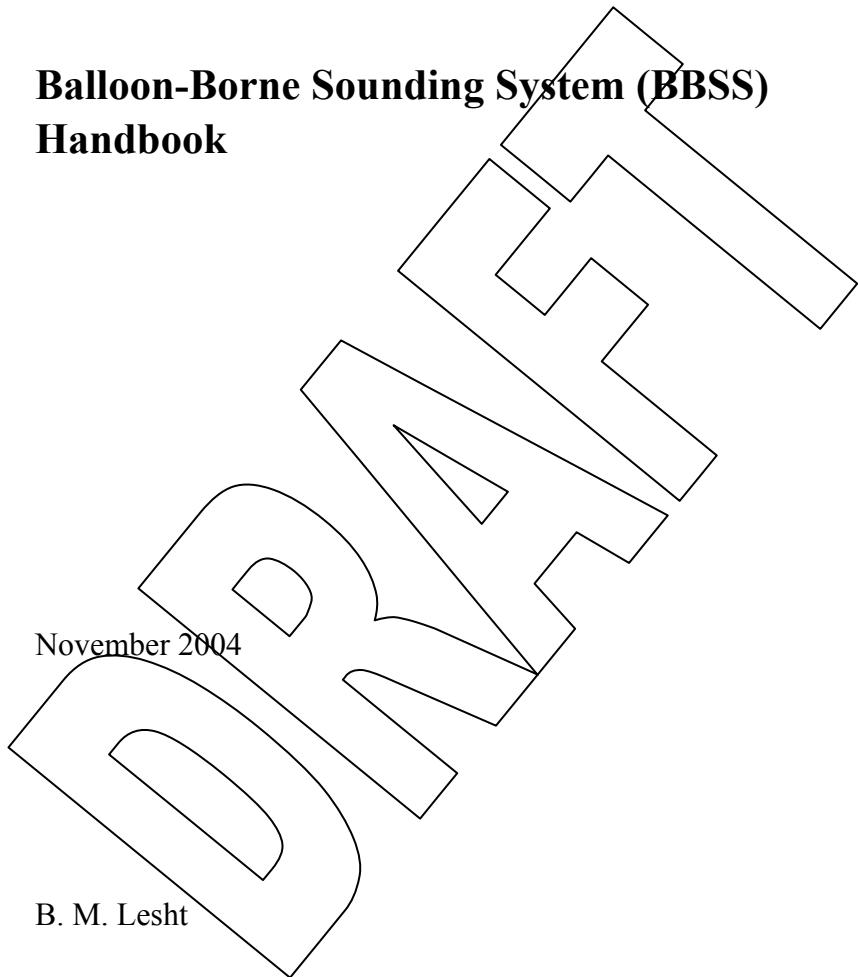


**Balloon-Borne Sounding System (BBSS)
Handbook**



Work supported by the U.S. Department of Energy,
Office of Science, Office of Biological and Environmental Research

Contents

1.	General Overview	1
2.	Contacts.....	1
3.	Deployment Locations and History.....	1
4.	Near-Real-Time Data Plots	3
5.	Data Description and Examples	3
6.	Data Quality	10
7.	Instrument Details	14

Figures

Figure 1.	Sample Comparisons of Sounding Profiles	12
Figure 2.	Sample Sonde Diagnostic Plots.....	13

Tables

Table 1.	Data Quality Min/Max Limits	5
Table 2.	15
Table 3.	15
Table 4.	Boundary Facilities (All, except as noted).....	16
Table 5.	TWP	16
Table 6.	NSA	16

1. General Overview

The balloon-borne sounding system (BBSS) provides in-situ measurements (vertical profiles) of both the thermodynamic state of the atmosphere, and the wind speed and direction.

2. Contacts

2.1 Mentor

Barry M. Lesht
Associate Division Director
Environmental Research Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439
Phone: 630-252-4208
Fax: 630-252-2959
e-mail: bmlesht@anl.gov

2.2 Instrument Developer

Vaisala, Inc.
100 Commerce Way
Woburn, MA 01801
Phone: (617)933-4500
Fax: (617)933-8029
www.vaisala.com

3. Deployment Locations and History

At the NSA site—

- Barrow, (Great White) 71.32N, 156.62W, 27 m
 - Install digiCORA-III (MW-21) 4/24/02
 - Install pc-CORA 7/22/02 (for AIRS validation IOP).

At the TWP site—

- Manus Island, PNG (ARCS1) 2.06S, 147.43E, 4 m
 - Assigned WMO station identifier (044 block 92)
 - Install Synergetics DCP 07/2000.
- Republic of Nauru (ARCS2) 0.52S, 166.92E, 7 m
 - Assigned WMO station identifier (532 block 91)
 - Install Synergetics DCP 07/2000.

At the SGP/CART site—

- Central Facility (CF) 36.61N, 97.49W, 315 m
 - System installed 5/27/92

- Start regular (19:30) soundings 7/14/92
- Start ground checks 1/21/93
- Change to high resolution sampling (2-sec) 5/20/93
- Install RESEARCH software 3/30/94
- Start RESEARCH mode soundings 4/7/94
- Stop RESEARCH mode soundings 5/21/94
- Stop ground checks 8/3/94
- Install RAWDATA software 11/15/94
- Assigned WMO station identifier (646 block 74) 8/19/96
- Software upgrade to generate WMO-coded messages for NWS 3/24/97
- Install MW-15 digiCORA-II 9/1/97 for WVOP
- Change regular sounding schedule from 5 per day to 3 per day 11/14/97
- Add 0530 UTC sounding to regular schedule (1130, 2030, 2330) 11/30/98
- Switch from PC-CORA to digiCORA-II for soundings 4/13/99
- Update PC-CORA and digiCORA-II and MF-12 for Y2K 6/9/99
- Stop RESEARCH mode for winds 11/24/00
- Begin operational use of RS-90 radiosondes 5/1/01
- Change sounding schedule to 0530, 1130, 1730, 2330 8/1/01
- Transfer PC-CORA to NSA 6/24/02
- Begin MW-21 transition IOP 7/10/02.
- Hillsboro, KS (BF1) 38.30N, 97.30W, 447 m
 - Installed 1/18/94
 - Start RESEARCH mode soundings 4/7/94
 - Stop RESEARCH mode soundings 5/21/94
 - Installed directional antenna 3/28/96
 - Assigned WMO station identifier (547 block 74) 8/19/96
 - Start automatic generation of WMO-coded messages 10/28/96
 - Added GPS windfinding capability 3/25/97
 - Suspend daily soundings at all BFs 11/22/97
 - Update digiCORA and MF-12 for Y2K 6/11/99
 - Stop RESEARCH mode for winds 11/24/00.
- Vici, OK (BF4) 36.07N, 99.20W, 622 m
 - Installed 1/18/94
 - Start RESEARCH mode soundings 4/7/94
 - Stop RESEARCH mode soudnings 5/21/94
 - Installed directional antenna 7/1/96
 - Assigned WMO station identifier (641 block 74) 8/19/96
 - Start automatic generation of WMO-coded messages 10/28/96
 - Added GPS windfinding capability 3/26/97
 - Suspend daily soundings at all BFs 11/22/97
 - Update digiCORA and MF-12 for Y2K 6/11/99
 - Stop RESEARCH mode for winds 11/24/00.
- Morris, OK (BF5) 35.68N, 95.85W, 217 m
 - Installed 1/18/94
 - Start RESEARCH mode soundings 4/7/94
 - Stop RESEARCH mode soudnings 5/21/94

- Assigned WMO station identifier (650 block 74) 8/19/96
- Start automatic generation of WMO-coded messages 10/28/96
- Added GPS windfinding capability 3/27/97
- Suspend daily soundings at all BFs 11/22/97
- Update digiCORA and MF-12 for Y2K 6/11/99
- Stop RESEARCH mode for winds 11/24/00.
- Purcell, OK (BF6) 34.97N, 97.42W, 344 m
 - Installed 10/13/94
 - Removed borrowed directional antenna 2/17/95
 - Installed new directional antenna 10/2/95
 - Assigned WMO station identifier (651 block 74) 8/19/96
 - Start automatic generation of WMO-coded messages 10/31/96
 - Added GPS windfinding capability 3/25/97
 - Suspend daily soundings at all BFs 11/22/97
 - Update digiCORA and MF-12 for Y2K 6/11/99
 - Stop RESEARCH mode for winds 11/24/00.

4. Near-Real-Time Data Plots

Quicklooks are plots of collected data, of varying sophistication. Click on the links below to see current and recent plots of BBSS data. Some plots may be intended and are more useful for operational diagnostic or educational purposes than for scientific inquiry.

- [SGP](#)
- [NSA](#)
 - [Barrow](#) (click on the "nsaissonde10sC1.a1", variable, and proceed)
 - [SHEBA Ice Camp](#) (click on the "BBSS" variable and proceed).
- [TWP](#)
 - [Manus](#) (click on "View Plot" for the "Sonde" variable desired)
 - [Nauru](#) (click on "View Plot" for the "Sonde" variable desired).

5. Data Description and Examples

5.1 Data File Contents

5.1.1 Primary Variables and Expected Uncertainty

The following quantities are measured as functions of time during a free-balloon ascent:

- Pressure (hPa)
- Temperature (degC)
- Relative Humidity (%RH)

- Wind speed (m/s)
- Wind direction (deg).

Secondary (derived) quantities included in the data stream, also measured as functions of time, are:

- Altitude (gpm)
- Dew Point (degC)
- Ascent Rate (m/s)
- Latitude of Sonde (degN)
- Longitude of Sonde (degW)
- u-component of wind velocity (m/s)
- v-component of wind velocity (m/s).

5.1.1.1 Definition of Uncertainty

Several situations may arise during a sounding that may affect the quality of the data but which may not be flagged or otherwise corrected and the user should be aware of these. Among these are incorrect surface conditions, humidity sensor saturation or icing, and interference and signal confusion from other radiosondes. General data quality reports (DQRs) have been issued describing these conditions and the user is urged to read and understand these. Specific DQRs are issued for those cases when incorrect surface conditions are included in the soundings. Cases of sensor saturation (which may lead to unrealistic lapse rates or humidity values aloft, and of sonde-to-sonde interference which may result in incorrect data values are not generally called out in individual DQRs.

A general problem with Vaisala radiosondes is that they seem to exhibit a dry bias; that is, the RH values reported are too low. The amount of the error varies with several factors including the ambient temperature and RH and the age of the radiosonde but may be as great as 10% RH. The dry bias results from contamination of the humidity sensor during storage. Starting in August of 1998 (week 33), Vaisala changed their packaging to reduce the problem. Another packaging change was made in August of 2000 that should effectively eliminate it from the RS-80 series of sondes. More detailed information may be found below in the FAQ, "What is this about dry bias in Vaisala radiosondes?"

Another issue involves soundings that are done in so-called RESEARCH mode for PTU (pressure, temperature, and humidity). These soundings, which may identified by data platform name wXpr, were done regularly at the SGP from 4/27/94 to 5/21/94; other cases isolated cases may exist in the archived data. Soundings done using RESEARCH mode (for PTU) Vaisala processing have a negative bias in the calculation of sonde altitude. This bias results from neglecting the sensed relative humidity when calculating air density when integrating the hydrostatic equation. In essence, the Vaisala RESEARCH mode (PTU) processing assumes a dry atmosphere when calculating sonde altitude. The magnitude of the bias is cumulative with height and will depend on the vertical distribution of moisture, but it can be as much as 20 meters at the tropopause (the RESEARCH-mode sounding altitudes will be smaller than altitudes calculated by using sensed RH). This problem applies to all soundings done in 'WXPR' mode, where X is either R or N. In particular, all soundings done during the April 1994 (RCS) IOP (4/7/94 to 5/21/94) are affected as well as those occasional inadvertent WXPR soundings. Note that the only variable affected is 'alt.'

Users interested corrected data for this time period should obtain files named as listed below. They can be retrieved via the Query Interface at the Archive or by special request to Archive User Services (armarchive@ornl.gov).

- DsgpsondeptucalcB1.c1
- DsgpsondeptucalcB4.c1
- DsgpsondeptucalcB5.c1
- DsgpsondeptucalcC1.c1.

5.1.2 Secondary/Underlying Variables

This section is not applicable to this instrument.

5.1.3 Diagnostic Variables

This section is not applicable to this instrument.

5.1.4 Data Quality Flags

Some automated data quality checks are included in the processed BBSS netCDF file. Checks now used are based on pre-defined limits for maximum, minimum, and sample-to-sample change (delta) values of each raw variable. The following limits are used for BBSS:

Table 1. Data Quality Min/Max Limits

Variable	Name	Units	SGP			TWP			NSA		
			Min	Max	Delta	Min	Max	Delta	Min	Max	Delta
pres	pressure	hPa	0.0	1100.0	10.0	0.0	1100.0	10.0	0.0	1100.0	50.0
tdry	dry bulb temperature	C	-80.0	50.0	10.0	-80.0	50.0	10.0	-80.0	50.0	50.0
dp	dewpoint temperature	C	-110.0	50.0	----	-110.0	50.0	----	-110.0	50.0	50.0
wspd	wind speed	m/s	0.0	75.0	----	0.0	75.0	----	----	----	----
deg	wind direction	deg	0.0	360.0	----	0.0	360.0	----	----	----	----
rh	relative humidity	pct	0.0	100.0	----	0.0	100.0	----	0.0	100.0	----
u_wind	eastward wind component	m/s	-100.0	100.0	----	-100.0	100.0	----	----	----	----
v_wind	northward wind component	m/s	-100.0	100.0	----	-100.0	100.0	----	----	----	----
wstat	wind status	none	0.0	----	----	0.0	----	----	----	----	----
asc	ascent rate	m/s	-10.0	20.0	5.0	-10.0	20.0	5.0	-10.0	20.0	5.0

An example BBSS file header (Data Object Design), which contains information on BBSS automated QC, may be found for SGP and TWP at [SONDE](#) (once there, click on "sondewnlpn.b1_new") and for NSA at [ISSSONDE](#) (once there, click on "isssonnde10s.a1_new").

5.1.5 Dimension Variables

This section is not applicable to this instrument.

5.2 Annotated Examples

This section is not applicable to this instrument.

5.3 User Notes and Known Problems

General

Several situations may arise during a sounding that may affect the quality of the data but which may not be flagged or otherwise corrected, and the user should be aware of these. Among these are incorrect surface conditions, humidity sensor saturation or icing, interference and signal confusion from other radiosondes. General data quality reports (DQRs) have been issued describing these conditions and the user is urged to read and understand these. Specific DQRs are issued for those cases when incorrect surface conditions are included in the soundings. Cases of sensor saturation (which may lead to unrealistic lapse rates or humidity values aloft, and of sonde-to-sonde interference which may result in incorrect data values are not generally called out in individual DQRs.

Dry Bias

A general problem with Vaisala radiosondes is that they seem to exhibit a dry bias; that is, the RH values reported are too low. The amount of the error varies with several factors including the ambient temperature and RH and the age of the radiosonde but may be as great as 10% RH. The dry bias results from contamination of the humidity sensor during storage. Starting in August of 1998 (week 33), Vaisala changed their packaging to reduce the problem. Another packaging change was made in August of 2000 that should effectively eliminate it from the RS-80 series of sondes. More detailed information may be found in a FAQ below, called "**What is this about 'dry bias' in Vaisala radiosondes?**".

STATUS Message

Soundings done at the SGP (BFs and CF digiCORA) and at the TWP include a STATUS message in the netCDF metadata. This STATUS message contains information about the overall quality of the sounding. Among the information included in the status message is the percent of good telemetry, and the percent of samples that did not pass the internal quality checks. The format of the STATUS message is explained below in the FAQ section.

5.4 Frequently Asked Questions

Why are BBSS data files from the NSA named differently than SGP and TWP files?

The BBSS system located at Barrow is an old CLASS-type (Cross-chain Loran Atmospheric Sounding System) that was originally operated by CMDL on Manus. The NSA filenames (e.g., nsaisssonde10sC1.LL.YYYYMMDD.HHMMSS) reflect this provenance. The "iss" refers to the integrated sounding system of which this unit was once a part and the "10s" refers to the fact that each sample in the output file is calculated from a 10-s window of the raw (~1.5-s) data. As in all ARM data file names, the LL indicates the data level, and the YYYYMMDD.HHMMSS have their usual meanings.

File names from the SGP and TWP are named SSSsondewXpXFF.LL.YYYYMMDD.HHMMSS. The "SSS" refers to the site identifier (SGP or TWP), the wXpX indicates the type of processing mode that was applied to the data (X={N,R}, where N is "nominal" and R is "research"), FF identifies the facility within the site (for the SGP, FF={B1,B4,B5,B6,C1,S01} and for the TWP, FF={C1,C2})

Why don't the NSA BBSS files have any wind data?

The NSA CLASS system (despite its name) was based on Omega windfinding. The Omega navigation system was turned off in September 1997 and we use PTU (pressure, temperature, humidity) only radiosondes at NSA. It is likely that a new Vaisala ground station will be installed at Barrow in FY2001 and we will start providing upper-air wind data as well.

What is RESEARCH mode?

The standard data stream output by the BBSS ground station is passed through different levels of processing by the ground station before being sent to the site data system. The ground station processing consists of filtering, editing, and interpolation. Different sets of algorithms are applied to the wind and thermodynamic data. Data treated by the standard processing algorithms (full filtering, editing, and interpolation) are termed "NOMINAL" and identified in the data file name by the letter "n" following either the "w" (for winds) or "p" (for PTU). Thus, a sounding file with nominal processing applied to both winds and thermodynamic data would be named SSSsondewnpnFF. In RESEARCH mode the only processing applied to the PTU data is an 11-s window median filter (to eliminate telemetry noise). No other processing (including radiation correction of the temperature) is done. For winds, no editing, filtering, or interpolation is done in RESEARCH mode. The standard processing mode for SGP soundings up until 11/24/2000 was wrpn. Since 11/24/2000 we have been using wnpn processing modes for SGP soundings (see BCR-00304 for further discussion).

How do I parse the sonde serial number?

The radiosonde serial numbers are assigned when the sensor packs are calibrated. The numbers encode the date of calibration as well as other information. Prior to October 1995, the serial number code (for RS-80s) was:

DDMMYYTTPP, in which

DD = day of the month (1-31)
MM = month (1-12) + facility identifier (00, 20, 40, or 80)
Y = last digit of the year
TT = calibration tray identifier
PP = position in calibration tray

More recent radiosonde serial numbers are coded

YWWDTTTNNN, in which

Y = last digit of the year
WW = week number (1-52)
D = day of the week (1-7) Monday=1
TTT = calibration tray identifier
NN = position in calibration tray

RS-90 radiosondes (used operationally by ARM at SGP since 5/1/2001) are coded

YWWDSSSS, in which

Y = alphabetic code for the year (T=1998, U=1999, etc.)
WW = week number (1-52)
D = day of the week (1-7) Monday=1
SSSS = sequence number

How do I decode the 'Launch Status' metadata?

The Launch Status word is coded as follows:

SmSmSmSmSmSmSmSmSm NNNNNNNNNNNNNNN
IIii
YrYrMoMoDaDa HrHrMnMn
SnSnSnSnSnSnSn
PcoPcoPco TcoTcoTco UcoUcoUco
ChnChnChn
PacPacPac PmdPmdPmd PrjPrjPrj
TacTacTac TmdTmdTmd TrjTrjTrj
UacUacUac UmdUmdUmd UrjUrjUrj
PmiPmiPmi TmiTmiTmi UmiUmiUmi
TiTiTi RRR HeHeHe
AoAoAo BoBoBo CoCoCo
DoDoDo EoEoEo FoFoFo
GoGoGo HoHoHo
aaaoao bobobo cococo

Where:

SmSmSm...	sounding number
NNN...	station name
II	WMO block number

iii	international station number
YrYrMoMoDaDa	date of sounding
HrHrMnMn	time of balloon release
SnSnSn...	radiosonde serial number
PcoPcoPco	ground check correction for pressure in tenths of a hPa
TcoTcoTco	ground check correction for temperature in tenths of a degC
UcoUcoUco	ground check correction for humidity in %RH
ChnChnChn	percentage of successful attempts to identify signal sequence
PacPacPac	accepted levels of P (%)
PmdPmdPmd	replaced levels of P (%)
PrjPrjPrj	rejected levels of P (%)
TacTacTac	
TmdTmdTmd	as for P
TrjTrjTrj	
UacUacUac	
UmdUmdUmd	as for P, T
UrjUrjUrj	
PmiPmiPmi	maximum interpolated layer in 10
TmiTmiTmi	second units for PTU profiles
UmiUmiUmi	
TiTiT	duration of ascent in 10 second units
RRR	reason for termination
001	stop command
004	maximum interpolation time of pressure or temperature exceeded
005	increasing pressure
006	prelaunch set limit exceeded
010	no PTU signal
HeHeHe	altitude reach in units of 100m

For Loran soundings (SGP)

AoAoAo	station in wind calculations (%)
BoBoBo	Master stations are AoAoAo and
...	GoGoGo. Others are slave stations
HoHoHo	
...	
cococo	

For GPS soundings (TWP)

AoAoAo	percentage of valid raw wind levels
BoBoBo	percentage of valid raw wind levels which have at least 5 satellites in track
CoCoCo	percentage of valid raw wind levels which have at least 4 satellites in track

DoDoDo	percentage of raw wind levels rejected due to poor PDOP
EoEoEo	percentage of raw wind levels which have unidentified channel in solution
FoFoFo	not used
GoGoGo	10*mean track count of all levels
HoHoHo	10*mean track count of valid levels
aoaoao	cumulative minutes of long (>1min) time gaps
bobobo	not used
cococo	not used

What is this about "dry bias" in Vaisala radiosondes?

Since the beginning of the program, ARM has conducted ongoing data quality studies involving comparisons among different instruments. One of the oldest of these compares the perceptible water vapor (PWV) retrieved, from the CART microwave radiometer (MWR) with the PWV calculated from the radiosonde soundings. Over the years these comparisons have helped to detect problems with both these and other CART instruments. After collecting years of data it became apparent that sequences of radiosonde launches showed lower PWV than the MWR. At first this finding was thought to be due to batch-to-batch calibration variations. Indeed ARM discovered that a large batch of Vaisala radiosondes were incorrectly calibrated in November 1994 (see DQR960229.1).

More recent work has shown that the batch-to-batch variability in RH results from contamination of the humidity sensor by organic vapors originating in the plastic parts of the radiosonde. The effect of the contamination is to reduce the number of polymer binding sites available for water vapor and thus bias the sensor output low. A Problem Identification Report (PIF990129.5) describing the bias problem has been filed.

Vaisala has developed a proprietary processing algorithm that is supposed to correct the radiosonde data for the dry bias. The problem and the algorithm is described in some detail in two papers that were presented at the 1999 ARM Science Team meeting. PDF versions of these papers are available by clicking the links below:

Lesht, B.M. 1999. [Reanalysis of radiosonde data from the 1996 and 1997 water vapor intensive operations periods: Application of the Vaisala RS-80H contamination correction algorithm to dual-sonde soundings.](#)

Miller, E.R., J. Wang, and H.R. Cole. 1999. [Correction for dry bias in Vaisala radiosonde RH data.](#)

6. Data Quality

6.1 Data Quality Health and Status

The following links go to current data quality health and status results:

- [DQ HandS](#) (Data Quality Health and Status)

- [NCVweb](#) for interactive data plotting using.

The tables and graphs shown contain the techniques used by ARM's data quality analysts, instrument mentors, and site scientists to monitor and diagnose data quality.

Click on one of the links below to look at the current/recent data quality or operational health and status of BBSS. These various sources will provide you with an idea of how ARM data quality analysts, instrument mentors, site scientists, and site operators closely monitor instrument performance in the real time.

- **SGP**

[Data Quality Health and Status](#)

[Sounding Status Reports](#)

[Prelaunch Logs](#)

[Data Availability](#) (click on desired time period and then locate "BBSS").

- **NSA**

[Barrow - Current Health and Status](#) (look for "Sonde ASCII File Count")

[Atqasuk - Current Health and Status](#) (look for "Sonde ASCII File Count").

- **TWP**

[Manus - Current Health and Status](#) (look for six "Sonde" diagnostics)

[Nauru - Current Health and Status](#) (look for six "Sonde" diagnostics).

6.2 Data Reviews by Instrument Mentor

The BBSS Instrument Mentor (Barry Lesht) performs a number of tasks to assure the quality of BBSS data. Data quality control procedures for this system are considered **mature**.

- **QC frequency:** Daily
- **QC delay:** Real-time; weekly
- **QC type:** Min/max/delta flags; graphical plots; mentor reviews
- **Inputs:** Raw data files
- **Outputs:** Hard copy plot of every sounding
- **Reference:** None

Standard BBSS data are subject to several levels of quality control and quality assurance. The process of converting the raw 1.5-second PTU samples to values output every 2 seconds involves filtering, editing, and interpolation intended to provide the best estimate of the atmospheric state at every level. The details of the processing are not well documented. They are being analyzed by the instrument mentor and more information will be provided when it is available.

Daily logs that include operator comments regarding the system and a listing of DQ flags set during the ingest are sent to instrument mentor. He reviews these logs practically every day.

The mentor makes a hard-copy plot of every sounding daily. He examines the plots for features that may suggest a DQ problem that did not set one of the automatic flags. The plots also are used to verify and evaluate the DQ problems identified by the automatic procedures. If a problem is significant enough to highlight, he writes and submits a DQR for data users and submits a DQPR to site operators (SGP) to initiate corrective maintenance.

The mentor receives weekly output from the ongoing QME involving the BBSS and the microwave radiometer (MWR) ([QMEMWRCOL](#)). He processes this output to evaluate the longer-term performance of the radiosondes by comparison with the MWR, with special attention to sonde calibration lot. If it appears that a particular calibration lot may have a DQ problem, he (1) issues a request to site operations personnel to hold all remaining radiosondes from the questionable lot, (2) issues a DQR related to all soundings done using radiosondes from the questionable lot, and (3) contacts the manufacturer to arrange for special re-testing of the sondes from the questionable lot.

The mentor also does a weekly comparison of the surface values of pressure, temperature, and humidity for each sounding with the coincident measurements obtained by the co-located THWAPS system. These comparisons help to highlight operator data entry problems or calibration errors. Sample comparisons (left) and sounding profiles (right) are provided below.

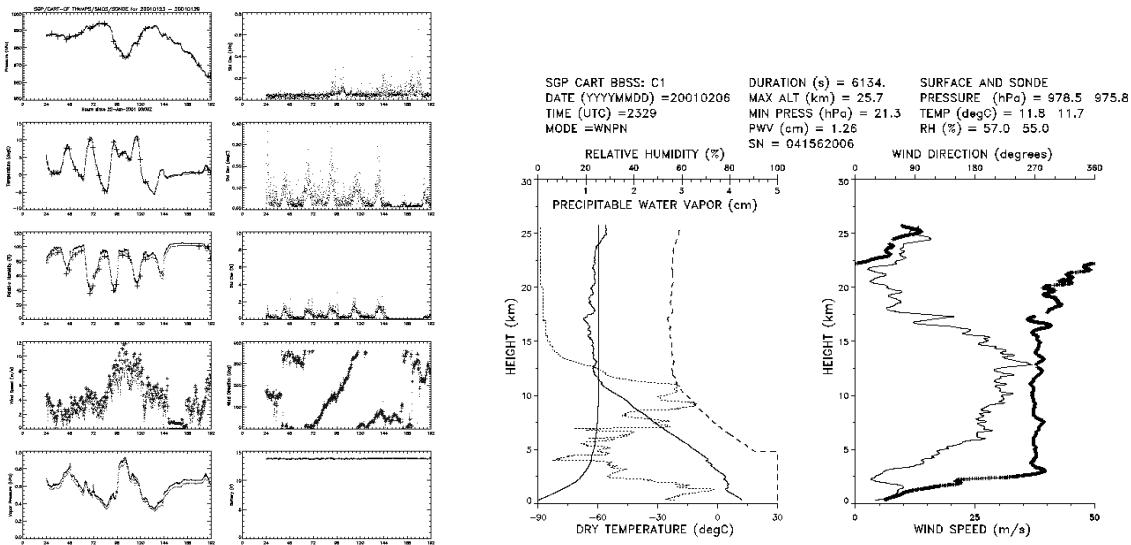


Figure 1. Sample Comparisons of Sounding Profiles

6.3 Data Assessments by Site Scientist/Data Quality Office

The **SGP Site Scientist Team and Data Quality Office** extract automated flag information from BBSS files to produce tables of color-coded flag status. It also performs visual inspections of Skew-T/log p plots (from the NSDL Quicklooks web site), comparisons of sonde and 60-m tower temperature and relative

humidity (CF site only), and comparison plots of THWAPS, SMOS, EBBR, and CM for temperature, humidity, and pressure (CF only). A weekly assessment report is issued to the Instrument Mentor and SGP Site Operations in which data are verified as suitable for use, or irregularities are noted. Such mentor and site scientist results then trigger the writing of appropriate DQPRs (SGP) to initiate corrective maintenance and ARM DQRs for data users.

To see these color status tables and BBSS plots, go to the [SGP Data Quality Health and Status site](#). Once there, you will see a color status table for the present month. To see the color status for the launches of a particular day, pick a site and day, toggle "Submit Request", and this will reveal the color status tables of the launches made that day. If you place your mouse over non-green boxes, a pop-up will reveal which flags were tripped and at what percentage. Click on "Diagnostic Plot" for the launch you are interested in to see its visuals and the NSDL quicklook for the Skew-T/log p.

The **NSA Site Scientist Team** makes visual inspections of various sonde quicklooks and VAP-like quicklooks it has developed. For the sondes, profiles of air temperature, dewpoint temperature, relative humidity, and water vapor are produced at 10-second averages over 0-1 km and 0-10 km profiles, respectively. Total column water vapor is also derived and compared to that from the MWR to detect possible discrepancies. On-line versions of such plots can be seen from the NSA quicklook server links in "[Data Quicklooks \(near real-time\)](#)" below.

Two sample sonde diagnostic plots that can be found on the NSA quicklook server are shown below, one for the 0-1 km profile (left) and another for 0-10 km profile (right):

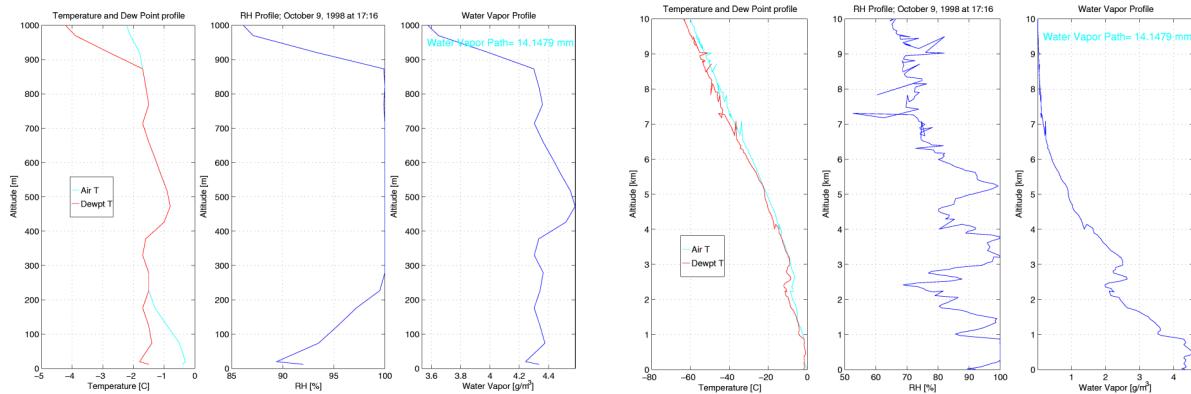


Figure 2. Sample Sonde Diagnostic Plots

The **TWP Site Scientist Team** tests for missing sondes. Total column water vapor is derived and compared to that from the MWR to detect possible discrepancies. Diagnostic plots and further sonde checks are currently under construction.

6.4 Value-Added Procedures and Quality Measurement Experiments

Many of the scientific needs of the ARM Program are met through the analysis and processing of existing data products into "value-added" products or VAPs. Despite extensive instrumentation deployed at the ARM CART sites, there will always be quantities of interest that are either impractical or impossible to

measure directly or routinely. Physical models using ARM instrument data as inputs are implemented as VAPs and can help fill some of the unmet measurement needs of the program. Conversely, ARM produces some VAPs not in order to fill unmet measurement needs, but instead to improve the quality of existing measurements. In addition, when more than one measurement is available, ARM also produces "best estimate" VAPs. A special class of VAP called a Quality Measurement Experiment (QME) does not output geophysical parameters of scientific interest. Rather, a QME adds value to the input datastreams by providing for continuous assessment of the quality of the input data based on internal consistency checks, comparisons between independent similar measurements, or comparisons between measurement with modeled results, and so forth. For more information, see the [VAPs and QMEs](#) web page.

BBSS-related VAPs include:

- [LSSONDE](#) – Produces radiosonde profiles in which the moisture profile is scaled to match MWR total perceptible water vapor.

BBSS-related QMEs include:

- [QMEMWRCOL](#) – Results from this QME are used to evaluate the MWR and radiosondes.
- [QMEMWRPROF](#) – Comparisons of retrieved water vapor and temperature profiles from mwrprof with radiosonde profiles.
- [QMEAERIPROF](#) – This QME helps to assess the ability of the radiosondes and in-situ tower measurements to observe moisture and temperature in the atmosphere.
- [QMEAERILBLCLOUDS](#) – Uses radiosonde pressure, temperature, and moisture data as input.

7. Instrument Details

7.1 Detailed Description

7.1.1 List of Components

The BBSSs consist of disposable radiosondes and fixed ground stations. All facilities use the same basic radiosondes, but the ground stations differ somewhat. The SGP and TWP use Vaisala ground stations; the NSA uses a CLASS-type (Cross-Chain Loran Atmospheric Sounding System) that originally belonged to NOAA/CMDL. The NSA CLASS system will be replaced with a new Vaisala ground station in summer 2002.

Radiosondes:

- Manufacturer: [Vaisala, Inc.](#)
- SGP: RS80-15LH (Loran-C windfinding, H-Humicap, 403 MHz) through April, 2001
- RS90-AL (Loran-C windfinding, dual humicap) beginning May, 2001
- TWP: RS80-15GH (GPS windfinding, H-Humicap, 403 MHz) through May, 2002 RS90-AG (GPS windfinding, dual humicap) beginning June, 2002
- NSA: RS80-15H (PTU only, H-Humicap, 403 MHz) used with CLASS through April, 2002
- RS90-A (PTU only, dual humicap) beginning April 25, 2002
- RS90-AG Occasionally in use beginning April 25, 2002.

Ground Stations:**SGP Central Facility**

We have two ground stations at the SGP Central Facility, digiCORA-II and a digiCORA-III. The digiCORA-II is the production system (data platform name sgpsondewXpXC1) and the digiCORA-III is being tested as a replacement (scheduled for late summer 2002). During the summer of 2002 two additional digiCORA-I systems will be used at the SGP for the AIRS validation IOP. See [AIRS IOP](#). These systems will be designated "supplemental" with data platform names sgpsondewXpXS01 and sgpsondewXpXS02. The pcCORA system formerly at the SGP was sent to the NSA site for use during the AIRS validation IOP. See [AIRS IOP](#).

Table 2.

Manufacturer:	Vaisala, Inc.	
Station Type:	MW-15	digiCORA-II
Components:	UPP-20	Receiver Processor
	URR-20	UHF Receiver
	MWV-201	Navaid Processor
	MWG-201	GPS Processor
	RM-21	UHF Antenna
	GA-20	GPS Antenna
	MF-12	Floppy Disk (DD) Drive

Table 3.

Manufacturer:	Vaisala, Inc.	
Station Type:		PC-CORA
Components:	PC	486 Windows 3.1
	UR-15	UHF Receiver
	SPL-11	Loran Receiver
	SPU-11	Loran Processor
	CG-21	Antenna Set including: <ul style="list-style-type: none">• CAS-21 VLF Antenna• RM-21 UHF Antenna• RAA-20M Antenna Amplifier.
	GC-22	Ground Check Set

Table 4. Boundary Facilities (All, except as noted)

Manufacturer:	Vaisala, Inc.	
Station Type:	MW-11	digiCORA
Components:	MF-12	Floppy Disk (DD) Drive
	UPP-15A	Receiver Processor
	UPP-20	Receiver Processor (B6)
	UIF-15A	IF Unit (B1, B4, B5)
	URO-15	Oscillator (B1, B4, B5)
	URR-20	UHF Receiver
	RB-21	Directional UHF Antenna

Table 5. TWP

The ground stations at ARCS1 (Manus Island, PNG) and ARCS2 (Republic of Nauru) are identical digiCORA-IIs.

Manufacturer:	Vaisala, Inc.	
Station Type:	MW-15	digiCORA-II
Components:	UPP-20	Receiver Processor
	URR-20	UHF Receiver
	MWV-201	Navaid Processor
	MWG-201	GPS Processor
	RM-21	UHF Antenna
	GA-20	GPS Antenna
	PCM	Raw Data Collection Software

Table 6. NSA

The ground station at Barrow, AK is an old CLASS-type (Cross Chain Loran Atmospheric Sounding System).

Manufacturer:		
Station Type:		CLASS

7.1.2 System Configuration and Measurement Methods

Original sampling rate (5/27/92 to 5/30/93):

The raw sampling rate of thermodynamic sensors is approximately 1.5 seconds. The rate at which processed data is output to the data stream is programmable. For the first several months of operation at the Southern Great Plains/Cloud and Radiation Testbed (SGP/CART) site, we used a scheme in which PTU and wind data were output at three different rates, depending on the time into the sounding. These sampling rates were:

- Sample output every 10 seconds from 0 to 120 seconds into the flight.

- Sample output every 30 seconds from 120 to 900 seconds into the flight.
- Sample output every 60 seconds from 900 seconds to the end of the flight.

Sampling rate (NSA) to 5/1/02:

- Thermodynamic variables (PTU) output every 10 seconds throughout the flight.
- Wind variables (speed, direction) were not measured.

Sampling rate (SGP/TWP) from 6/1/93 to 11/24/00:

- Thermodynamic variables (PTU) output every 2 seconds throughout the flight.
- Wind variables (speed, direction):
 - Output every 10 seconds (SGP)
 - Output every 2 seconds (TWP).

Current Sampling rate (SGP/TWP/NSA):

- Thermodynamic variables (PTU) output every 2 seconds throughout the flight.
- Wind variables (speed, direction) output every 2 seconds throughout the flight.

Balloons and rate of ascent:

ARM uses 350 g balloons at all sites. The nominal ascent rate is approximately 5 m/s, although this is variable during the flight. The data file includes a variable 'asc' which, for each sample, estimates the current rate of ascent. This rate is actually a 30-second average rise rate based on the calculated sonde altitudes.

Software Configuration of the SGP digiCORA Systems

The following is the current software configuration listing for the Vaisala MW-11 digiCORA systems now in use at the Southern Great Plains Cloud and Radiation Testbed site. These systems are installed at BF1 (Hillsboro, KS), BF4 (Vici, OK), BF5 (Morris, OK), and BF6 (Purcell, OK). The configuration listings show the installed software applications as well as their version numbers.

Configuration 10 JUN 99 14:23 UTC
Installed software:

Programs of processors

MPUS	8.28	7226
MWSS	7.32	5184
MPPS	4.02	7041
MWLS	4.03	5230
MWGS20	2.02	8272 SE1E99
UPP710	7.10	0290

Loadable programs

CONFIG 08.21 8030 MW11.8222

SYSPUP	08.29	7315	SYSP829A
SYSGEN	08.28	7310	SYSG828B
HIMEM	08.21	5062	HIMEM_MOD
DISPSERV08.27		7295	DISP827
SWSSERV	08.21	7300	SWSS821
PTUSERV	08.29	7295	PTUS829B
PCSERV	08.24	7162	PCSE824
LORSERV	08.28	7330	LORS828_MWL
GPSSERV	08.29	7330	GPSS829
MFSERV	08.21	4341	MFSE821
SOND	08.29	7349	SOND829D
LORWCMP	08.23	5285	LORW823
GPSWCMP	08.28	7286	GPSW828A
NAVDER	08.27	7314	NAVD827
SIMUL	08.21	5066	SIMUL_MOD
SIGPAR	08.21	5066	SIGPAR_MOD
COMPAR	08.21	5066	COMPAR_MOD
FORMOUT	08.21	5066	FORMOUT_MOD
ADDOUT	08.21	5066	ADDOUT_MOD
RESEARCH08.21		5066	RESEARCH_MOD
TEMP	08.24	7244	TEPI824_RT
PILOT	08.24	7244	TEPI824_RT
LIST	08.22	5289	LIST822
STATUS	08.22	5268	STAT822
MFLOAD	08.22	7086	MFLO822
MFSAVE	08.21	5066	MFSA821
METPAR	08.21	5178	METP821

The following is the configuration listing for the Vaisala digiCORAI now in use at the Southern Great Plains Cloud and Radiation Testbed site. This system is installed at the Central Facility.

Configuration 9 JUN 99 22:08 UTC
Installed software:

Programs of processors

MPUS	8.28	7226	
PPCS	1.11	6082	
UPPS20	3.03	7192	
MWVS20	04.21	7330	
MWGS20	2.02	8272	SE1E99

Loadable programs

CONFIG	08.21	8030	MW15.8222
SYSPUP	08.29	7315	SYSP829A
SYSGEN	08.28	7310	SYSG828B
HIMEM	08.21	5062	HIMEM_MOD
DISPSERV08.27		7295	DISP827
SWSSERV	08.21	7300	SWSS821
PTUSERV	08.29	7295	PTUS829B
PCSERV	08.24	7162	PCSE824
OMESERV	08.27	7330	OMES827
VLFSERV	08.27	7330	VLFS827
LORSERV	08.28	7330	LORS828
GPSSERV	08.29	7330	GPSS829

MFSERV	08.21	4341	MFSE821
SOND	08.29	7349	SOND829D
OMEWCMP	08.25	7309	OMEW825
LORWCMP	08.23	5285	LORW823
GPSWCMP	08.28	7286	GPSW828A
NAVDER	08.27	7314	NAVD827
SIMUL	08.21	5066	SIMUL_MOD
SIGPAR	08.21	5066	SIGPAR_MOD
COMPAR	08.21	5066	COMPAR_MOD
FORMOUT	08.21	5066	FORMOUT_MOD
ADDOUT	08.21	5066	ADDOUT_MOD
RESEARCH	08.21	5066	RESEARCH_MOD
TEMP	08.24	7244	TEPI824_RT
PILOT	08.24	7244	TEPI824_RT
LIST	08.22	5289	LIST822
STATUS	08.22	5268	STAT822
MFLOAD	08.22	7086	MFLO822
MFSAVE	08.21	5066	MFS821
METPAR	08.21	5178	METP821

Current SYSGEN Listing

The following is a listing of the current SYSGEN (system program) for the MW11/MW15 digiCORA systems used at the SGP/CART site. This listing shows all the system parameter settings now in use.

```
SYSPAR Rev. 07.09 99-06-10 14:07:14
      Initialized: 97-11-11 12:10:00
Latest modification: 99-01-20 21:38:38
```

Device Type	MW11					
Line description	MWL	MF	MWG	SWS	PTP	PRT
Line status	On/Test	On	On/Test	Off	Off	On
Cable Number	I 4	P8(422)	I 6	P 5	P 4	P 2
Line speed (bps)	19200	19200	9600	1200	300	9600
Parity	None	None	None	None	None	None
Number of data bits	8	8	8	8	8	8
Number of stop bit	1	1	1	1	1	1
Line timeout	10	10	10	30	10	10
Terminal / FM source	HCopy	HCopy	FMcable	HCopy	HCopy	EpsonFX
XON/XOFF type	Off	Off	Off	Off	Normal	Off
Line description	PRT2	CRT1	PC	EXT1	EXT_PTU	
Line status	Off	Off	On	Off	Off	
Cable Number	P 3	P 3	P 1	P 4	P 5	
Line speed (bps)	1200	9600	9600	9600	2400	
Parity	None	None	None	None	None	
Number of data bits	8	8	8	8	8	
Number of stop bits	1	1	1	1	1	
Line timeout	10	10	10	10	10	
Terminal / FM source	EpsonFX	WY-50	HCopy	HCopy	HCopy	
XON/XOFF type	Normal	Normal	Off	Normal	Off	

```
SYSPAR Rev. 07.09 99-06-10 14:07:19
      Initialized: 97-11-11 12:10:00
```

Latest modification: 99-01-20 21:38:38

Station data parameters
Latitude (deg) 38.30 deg
Longitude (deg) -97.30 deg
Altitude 447 m
WMO Region Code 4
WMO Block Code 74
WMO Station number 547
Station name SGP/CART/HILLSBORO1
Station report type FIXED
Coordinate input Disabled
Simulation option On
Research mode option On
Store data option On
Ground check type Disabled
Sounding start type Auto
Maximum duration 120 min
Maximum height 40 km
Minimum pressure 3 hPa
Ground obs type Operator
Unit for Ground T degC
Unit for Ground Dir deg
Unit for Ground Spe m/s
TEMP Section 7 On
Cloud group input Off
Special group1 input Off
Special group2 input Off
Sounding number flag On
Message time input None

SYSPAR Rev. 07.09 99-06-10 14:07:24
Initialized: 97-11-11 12:10:00
Latest modification: 99-01-20 21:38:38

Output control parameters
Output layer rec 1:
Type of use Ascent
Output device PRT P 2
Output data type 0
Layer start 1: 0 s
Record interval 1: 2 s
Layer start 2: 14400 s
Record interval 2: 0 s
Output header flag Off

Output record in use
Time AscRate Hgt/MSL Pressure Temp RH Dewp Dir Speed WndStat
min s m/s m hPa degC % degC deg m/s
xxx xx xxxxx.x xxxxxxxx xxxxx.x xxxx.x xxx xxxx.x xxxx xxx.x xxxxxxxxx

Output record 1:
Time AscRate Hgt/MSL Pressure Temp RH Dewp Dir Speed WndStat
min s m/s m hPa degC % degC deg m/s
xxx xx xxxxx.x xxxxxxxx xxxxx.x xxxx.x xxx xxxx.x xxxx xxx.x xxxxxxxxx

Message processing parameters

Message program	TEMP A
Processing status	On
Message triggering	AftTerm
Message distribution	Auto
Msg output line	PRT P 2
Header	None
Footer	1
Conversion /PRT	ASCII
Msg output line	PTP Off
Header	None
Footer	2
Conversion /PTP	TELEX
Reverse bit order	No
Message program	TEMP B
Processing status	On
Message triggering	AftTerm
Message distribution	Auto
Msg output line	PRT P 2
Header	None
Footer	1
Conversion /PRT	ASCII
Msg output line	PTP Off
Header	None
Footer	2
Conversion /PTP	TELEX
Reverse bit order	No
Message program	STATUS
Processing status	On
Message triggering	AftTerm
Message distribution	Auto
Msg output line	PRT P 2
Header	1
Footer	None
Conversion /PRT	ASCII
Message program	TEMP D
Processing status	Off
Message triggering	Operator
Message distribution	Auto
Msg output line	PRT P 2
Header	1
Footer	None
Conversion /PRT	ASCII
Msg output line	PTP Off
Header	None
Footer	2
Conversion /PTP	TELEX
Reverse bit order	No
Message program	PILOT A
Processing status	Off
Message triggering	Operator

Message distribution	Auto	
Msg output line	PRT	P 2
Header	1	
Footer	None	
Conversion /PRT	ASCII	
Msg output line	PTP	Off
Header	None	
Footer	2	
Conversion /PTP	TELEX	
Reverse bit order	No	
Message program	PILOT B	
Processing status	Off	
Message triggering	Operator	
Message distribution	Auto	
Msg output line	PRT	P 2
Header	1	
Footer	None	
Conversion /PRT	ASCII	
Msg output line	PTP	Off
Header	None	
Footer	2	
Conversion /PTP	TELEX	
Reverse bit order	No	
Message program	PILOT C	
Processing status	Off	
Message triggering	Operator	
Message distribution	Auto	
Msg output line	PRT	P 2
Header	1	
Footer	None	
Conversion /PRT	ASCII	
Msg output line	PTP	Off
Header	None	
Footer	2	
Conversion /PTP	TELEX	
Reverse bit order	No	
Message program	PILOT D	
Processing status	Off	
Message triggering	Operator	
Message distribution	Auto	
Msg output line	PRT	P 2
Header	1	
Footer	None	
Conversion /PRT	ASCII	
Msg output line	PTP	Off
Header	None	
Footer	2	
Conversion /PTP	TELEX	
Reverse bit order	No	
Message program	TEMP C	
Processing status	Off	
Message triggering	Operator	
Message distribution	Auto	
Msg output line	PRT	P 2

Header	1
Footer	None
Conversion /PRT	ASCII
Msg output line	PTP Off
Header	None
Footer	2
Conversion /PTP	TELEX
Reverse bit order	No

Trigger record 1:	Off
Trigger record 2:	Off
Trigger record 3:	Off
Trigger record 4:	Off
Trigger record 5:	Off
Trigger record 6:	Off
Trigger record 7:	Off
Trigger record 8:	Off
Trigger record 9:	Off
Trigger record 10:	Off

General message parameters

TEMP wind speed unit	kts
Hdr Time round up	30 min
Hdr Time round down	30 min
Msg Time round up	30 min
Msg Time round down	30 min
Downwards extr level	1000 hPa
First PILOT STD Lev	850 hPa
PTU only TEMP	No
Shear group in maxw	Yes
New sect-> new line	No
Double space	Yes
More than two trops	No
Incl.incomplete trop	No
Nbr of groups/line	10
Min T to report DPD	-60 degC

Message standard levels

STD Pressure/Hgt 1:	1000	--
STD Pressure/Hgt 2:	925	--
STD Pressure/Hgt 3:	850	1500
STD Pressure/Hgt 4:	700	3000
STD Pressure/Hgt 5:	500	5400
STD Pressure/Hgt 6:	400	7200
STD Pressure/Hgt 7:	300	9000
STD Pressure/Hgt 8:	250	10500
STD Pressure/Hgt 9:	200	12000
STD Pressure/Hgt 10:	150	13500
STD Pressure/Hgt 11:	100	15900
STD Pressure/Hgt 12:	70	18300
STD Pressure/Hgt 13:	50	20700
STD Pressure/Hgt 14:	30	23700
STD Pressure/Hgt 15:	20	26400

STD Pressure/Hgt 16: 10 30900

Message fixed regional levels
Mess vert level par Pressure hPa
Message level 1: 900 hPa
Message level 2: 800 hPa
Message level 3: 600 hPa

Header text records:
Header record nbr 1:

<CR><LF>
<CR><LF>
~SWY2~SWM2~SWD2<SP>~SWH2:~SWM2<CR><LF>
<CR><LF>

Header record nbr 2;

<CR><LF>
<LF>
<LF>
<LF>
<LF>
<LF>
<LF>
<LF>
NNNN<CR><LF>

SYSPAR Rev. 07.09 99-06-10 14:07:35
Initialized: 97-11-11 12:10:00
Latest modification: 99-01-20 21:38:38

General PTU params:
Sonde type 0
Median window length 11
Computing density 2 s
GC limit/P 6.0 hPa
GC limit/T 2.0 degC
GC limit/RH 7.0 %
Autostart parameter:
Thresh of P change 5.0 hPa
Limit of P change 12.5 hPa
Nbr of peaks of P 0
Number of P samples 24
Max dt of starttimes 5 s
Number of starttimes 5
Autostop parameters:
P trigger for test 1080.0 hPa
Thresh of P change 5.0 hPa
Limit of P change 12.5 hPa
Number of P peaks 0
Number of P samples 24
Max time with no P 720 s

PTU editing params :
Max interp time /P 4 min
Max interp time /T 4 min
Max interp time /RH 2 min
Smoothing tol /T 0.5 degC
rawtgrad 1.2 K/100m
rawtcl -2.0 degC
rawttmx 30.0 degC
fricdmin -1.6 K/100m
fricdmax 1.4 K/100m
freedmin -1.4 K/100m
freedmax 1.2 K/100m
Smoothing tol /RH 5 %
Nbr of smooth /P 3
Nbr of smooth /T 3
Nbr of smooth /RH 3
T/U Siglev params :
Trop/ sigp effect On
Press/sigp effect On
Force 100hPa SigLev On
Force 1st EDT SigLev Off
Force T sigp -> RH Off
Lowest level/tropop 500.0 hPa
Threshold for isot 0.0 degC
Thickness for isot 20.0 hPa
RH change in isot 20 %
1st tolerance sigp/T 1.0 degC
P to change 1st->2nd 300.0 hPa
2nd tolerance sigp/T 2.0 degC
Tolerance sigp/RH 15 %
plimisoinv 300.0 hPa
RH tol / join to T 6 %

Wind Process params:
Max interp time 1 min
Edit buffer length 6
Editing level 100 %
Smooth buffer length 11
Smoothing level 30
Wind Siglev params :
1st tol for sigp/dd 10 deg
1st tol for sigp/ff 5.0 m/s
P to change 1st->2nd 3.0 hPa
2nd tol for sigp/dd 10 deg
2nd tol for sigp/ff 5.0 m/s
Speed limit for MAXW 30.0 m/s
Lowest level/MAXW 500.0 hPa
spddffthres 5.0 m/s
Force 100hPa siglev On
Force 1st EDT SigLev Off
Calm strata boundary Off
NIL strata boundary On
Level in NIL strata On
Wait incomplete maxw On
Use CAN_MAXFF Off
Dir tol / join to FF 6 deg

SYSPAR Rev. 07.09 99-06-10 14:07:39
 Initialized: 97-11-11 12:10:00
 Latest modification: 99-01-20 21:38:38

LoranC wind params:

Number of chains	2
Chain ID	1: 8970
Station OFF/ON	1: On
Station OFF/ON	2: On
Station OFF/ON	3: On
Station OFF/ON	4: On
Station OFF/ON	5: On
Chain ID	2: 9610
Station OFF/ON	1: On
Station OFF/ON	2: On
Station OFF/ON	3: On
Station OFF/ON	4: On
Station OFF/ON	5: On
Station OFF/ON	6: On

Buffer control param	Time
Start of layer	1: 0 s
Buffer length	1: 60 s
Start of layer	2: 14400 s
Buffer length	2: 0 s
Computation mode	Remote

Chain	Id	GRI	Slave	Delay	Latitude	Longitude
1	4970	49.70 ms			65.97 deg	60.31 deg
			1	11.000 ms	76.13 deg	60.22 deg
			2	25.000 ms	69.12 deg	35.67 deg
2	5930	59.30 ms			46.81 deg	-67.93 deg
			1	11.000 ms	41.25 deg	-69.98 deg
			2	25.000 ms	46.78 deg	-53.17 deg
			3	38.000 ms	52.38 deg	-55.71 deg
3	5970	59.70 ms			36.18 deg	129.34 deg
			1	11.000 ms	42.74 deg	143.72 deg
			2	31.000 ms	35.04 deg	126.54 deg
			3	42.000 ms	26.61 deg	128.15 deg
4	5990	59.90 ms			51.97 deg	-122.37 deg
			1	11.000 ms	55.44 deg	-131.26 deg
			2	27.000 ms	47.06 deg	-119.74 deg
			3	41.000 ms	50.61 deg	-127.36 deg
5	6731	67.31 ms			49.15 deg	-1.50 deg
			1	10.992 ms	43.74 deg	-1.38 deg
			2	24.986 ms	52.58 deg	-9.82 deg
			3	39.028 ms	54.81 deg	8.29 deg
6	7001	70.01 ms			68.64 deg	14.46 deg
			1	11.014 ms	70.91 deg	-8.73 deg
			2	27.034 ms	70.84 deg	29.22 deg
7	7030	70.30 ms			20.47 deg	44.58 deg
			1	11.000 ms	24.83 deg	50.57 deg
			2	26.000 ms	23.81 deg	42.85 deg
			3	40.000 ms	28.15 deg	34.76 deg
			4	56.000 ms	16.43 deg	42.80 deg

8	7270	72.70 ms		49.33 deg	-54.86 deg
			1 11.000 ms	46.78 deg	-53.17 deg
			2 25.000 ms	52.38 deg	-55.71 deg
9	7430	74.30 ms		37.06 deg	122.32 deg
			1 11.000 ms	31.07 deg	118.89 deg
			2 28.000 ms	42.72 deg	129.11 deg
10	7499	74.99 ms		54.81 deg	8.29 deg
			1 11.028 ms	49.15 deg	-1.50 deg
			2 26.986 ms	61.30 deg	4.70 deg
11	7950	79.50 ms		51.08 deg	142.70 deg
			1 11.000 ms	53.13 deg	157.70 deg
			2 30.000 ms	44.53 deg	131.64 deg
			3 46.000 ms	42.74 deg	143.72 deg
			4 61.000 ms	59.42 deg	143.09 deg
12	7960	79.60 ms		63.33 deg	-142.81 deg
			1 11.000 ms	57.44 deg	-152.37 deg
			2 26.000 ms	55.44 deg	-131.26 deg
			3 44.000 ms	65.24 deg	-166.89 deg
13	7980	79.80 ms		30.99 deg	-85.17 deg
			1 11.000 ms	30.73 deg	-90.83 deg
			2 23.000 ms	26.53 deg	-97.83 deg
			3 43.000 ms	27.03 deg	-80.11 deg
			4 59.000 ms	34.06 deg	-77.91 deg
14	7990	79.90 ms		38.87 deg	16.72 deg
			1 11.000 ms	35.52 deg	12.53 deg
			2 29.000 ms	40.97 deg	27.87 deg
			3 47.000 ms	42.06 deg	3.20 deg
15	8000	80.00 ms		53.13 deg	34.91 deg
			1 10.000 ms	61.76 deg	33.69 deg
			2 25.000 ms	53.13 deg	25.40 deg
			3 50.000 ms	44.89 deg	33.87 deg
			4 65.000 ms	53.29 deg	48.11 deg
16	8290	82.90 ms		48.74 deg	-109.98 deg
			1 11.000 ms	48.61 deg	-94.56 deg
			2 27.000 ms	44.00 deg	-105.62 deg
			3 42.000 ms	51.97 deg	-122.37 deg
17	8390	83.90 ms		31.07 deg	118.89 deg
			1 11.000 ms	23.72 deg	116.90 deg
			2 29.000 ms	37.06 deg	122.32 deg
18	8830	88.30 ms		23.81 deg	42.85 deg
			1 11.000 ms	24.83 deg	50.57 deg
			2 25.000 ms	20.47 deg	44.58 deg
			3 40.000 ms	28.15 deg	34.76 deg
			4 56.000 ms	16.43 deg	42.80 deg
19	8930	89.30 ms		34.40 deg	139.27 deg
			1 11.000 ms	26.61 deg	128.15 deg
			2 30.000 ms	24.29 deg	153.98 deg
			3 50.000 ms	42.74 deg	143.72 deg
			4 70.000 ms	36.18 deg	129.34 deg
20	8940	89.40 ms		49.15 deg	-1.50 deg
			1 12.000 ms	43.74 deg	-1.38 deg
			2 30.000 ms	54.81 deg	8.29 deg
21	8970	89.70 ms		39.85 deg	-87.49 deg
			1 11.000 ms	30.99 deg	-85.17 deg
			2 28.000 ms	42.71 deg	-76.83 deg
			3 44.000 ms	48.61 deg	-94.56 deg
			4 59.000 ms	36.51 deg	-102.90 deg

22	9007	90.07 ms		62.30 deg	-7.07 deg
			1	10.984 ms	70.91 deg
			2	23.952 ms	68.64 deg
			3	38.998 ms	61.30 deg
			4	52.046 ms	52.58 deg
23	9610	96.10 ms		36.51 deg	-102.90 deg
			1	11.000 ms	44.00 deg
			2	25.000 ms	35.32 deg
			3	40.000 ms	32.07 deg
			4	52.000 ms	26.53 deg
			5	65.000 ms	30.73 deg
24	9930	99.30 ms		36.18 deg	129.34 deg
			1	11.000 ms	35.04 deg
			2	22.000 ms	26.61 deg
			3	37.000 ms	34.40 deg
			4	51.000 ms	44.53 deg
25	9940	99.40 ms		39.55 deg	-118.83 deg
			1	11.000 ms	47.06 deg
			2	27.000 ms	38.78 deg
			3	40.000 ms	35.32 deg
26	9960	99.60 ms		42.71 deg	-76.83 deg
			1	11.000 ms	46.81 deg
			2	25.000 ms	41.25 deg
			3	39.000 ms	34.06 deg
			4	54.000 ms	39.85 deg
27	9970	99.70 ms		24.80 deg	141.33 deg
			1	11.000 ms	24.29 deg
			2	30.000 ms	42.74 deg
			3	55.000 ms	26.61 deg
			4	81.000 ms	13.46 deg
28	9990	99.90 ms		57.15 deg	-170.25 deg
			1	11.000 ms	52.83 deg
			2	29.000 ms	65.24 deg
			3	43.000 ms	57.44 deg
30	7970	79.70 ms		62.30 deg	-7.07 deg
			1	11.000 ms	68.64 deg
			2	26.000 ms	54.81 deg
			3	46.000 ms	64.91 deg
			4	60.000 ms	70.91 deg

SYSPAR Rev. 07.09 99-06-10 14:07:52

Initialized: 97-11-11 12:10:00

Latest modification: 99-01-20 21:38:38

GPS parameters:

Station type	FIXED
Range to launch site	0.00 km
Dir to launch site	0.00 deg
Alt to launch site	0 m
Station elev mask	3 deg
Calculation mode	Diff
Sonde elevation mask	3 deg
Ionos./tropos. model	No
Sounding type	1
Default vert. speed	5.0 m/s
Max sonde speed	120 m/s

Max sonde accel.	20 m/(s*s)
Detection threshold	43
IF lower bound	6500 Hz
IF upper bound	17500 Hz
Tight search	200 Hz
Coarse search	600 Hz
Filter type	5
Filter bank index	1
Maximum time delay	240 s
Minimum data density	0.40
Output rate	0.5 s
Timeout	600 s
FSK frequency type	Vaisala
Navigation aiding	None
UHF Receiver Params:	
IF Bandwidth	Wide
Track	Off
Afc	On
Scan	Off
Elevation	45
Azimuth	NE
Automatic antenna	On
Default frequency	401.00 MHz
1st spare frequency	400.01 MHz
2nd spare frequency	405.99 MHz

7.1.3 Specifications

The manufacturer's specifications for the thermodynamic sensors are as follows:

PRESSURE

Type: Capacitive aneroid
Range: 1060 hPa to 3 hPa
Resolution: 0.1 hPa
Accuracy: 0.5 hPa

TEMPERATURE

Type: Capacitive bead
Range: +60 degC to -90 degC
Resolution: 0.1 degC
Accuracy: 0.2 degC
Lag: <2.5 s (6 m/s flow at 1000 hPa)

HUMIDITY

Type: H-HUMICAP thin film capacitor
Range: 0 to 100 %RH
Resolution: 1 %RH
Accuracy: 2 %RH (0 to 80 %RH)
 3 %RH (80 to 100 %RH)
Lag: 1 s (6 m/s flow at 1000 hPa, +20 degC)

Note that the "accuracy" figures given by the manufacturer represent the standard deviation of the differences obtained from repeated calibrations. As such, these values are more properly termed

"precision." Operational experience at the SGP/CART site ([Lesht, 1995](#)) showed that the RMS error in RH was approximately 1% RH at low humidity and surface temperature and that the RMS error in temperature was approximately 0.3 deg C.

Winds

Wind information (SGP) is obtained by tracking the radiosonde's position using the Loran-C navigation system. The accuracy of the wind information depends on the configuration of the Loran-C stations that are used to locate the sonde. Loran-C coverage in the SGP/CART area is fairly good, and we estimate the accuracy of the wind speed to be approximately 0.5 m/s.

We use GPS (global positioning system) wind-finding at the TWP locations. This satellite-based navigation system is very precise and we estimate the accuracy of the wind velocity to be 0.2 m/s.

7.2 Theory of Operation

This section is not applicable to this instrument.

7.3 Calibration

7.3.1 Theory

This section is not applicable to this instrument.

7.3.2 Procedures

This section is not applicable to this instrument.

7.3.3 History

This section is not applicable to this instrument.

7.4 Operation and Maintenance

7.4.1 User Manual

This section is not applicable to this instrument.

7.4.2 Routine and Corrective Maintenance Documentation

General

- [General Preventative Maintenance Procedures](#) (highlight procedure and toggle "View Procedure Summary").

SGP

- [Specific SGP CF Preventative Maintenance Procedures](#)
- [Specific SGP BF Preventative Maintenance Procedures.](#)

7.4.3 Software Documentation

ARM netCDF file header descriptions may be found for BBSS at SGP and TWP at [Sonde](#) and for NSA at [ISSSonde](#).

7.4.4 Additional Documentation

This section is not applicable to this instrument.

7.5 Glossary

See the [ARM Glossary](#).

7.6 Acronyms

See the [ARM Acronyms and Abbreviations](#).

7.7 Citable References

Lesht, B.M. 1995. An Evaluation of ARM Radiosonde Operational Performance. *Proceedings of the Ninth Symposium on Meteorological Observations and Instrumentation*, pp. 6-10. American Meteorological Society, Boston, Massachusetts.

Lesht, B.M., and J.C. Liljegren. 1996. Comparison of Precipitable Water Vapor Measurements Obtained by Microwave Radiometry and Radiosondes at the Southern Great Plains CART site. *Proceedings of the Sixth ARM Science Team Meeting*. San Antonio, Texas.

Lesht, B.M. 1999. [Reanalysis of radiosonde data from the 1996 and 1997 water vapor intensive operations periods: Application of the Vaisala RS-80H contamination correction algorithm to dual-sonde soundings.](#)

Miller, E.R., J. Wang, and H.R. Cole. 1999. [Correction for dry bias in Vaisala radiosonde RH data.](#)